

REMARKS

Page 12, line 8 of the Disclosure has been amended, as set out above, in order to correct a typographical error with respect to the reference number used to refer to the “vapor phase product collection locations.”

Claims 1 - 25 are pending in this Application. No amendments are submitted herein.

Referring to the Office Action, the Examiner has rejected the Claims as follows:

- (a) **Claims 1 - 15, 19 - 21 and 25** have been rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 2,717,867 issued September 13, 1955 to Jewell et. al.;
- (b) **Claim 18** has been rejected under 35 U.S.C. 103(a) as being unpatentable over Jewell et. al.; and
- (c) **Claims 1, 16, 17 and 22 - 24** have been rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 2,895,906 issued July 21, 1959 to Harper.

It is respectfully submitted that these rejections of the Examiner are overcome by the remarks that follow.

Applicant's Invention

The Applicant's invention as claimed in independent Claim 1 is directed at a process for converting a liquid feed material into a vapor phase product comprising the following:

- (a) providing a **fluid bed comprising solid particles and a fluidizing medium, wherein the fluidizing medium is moving in a substantially vertical fluidizing direction** and wherein the solid particles are at a conversion temperature which is

suitable for facilitating the conversion of the liquid feed material to the vapor phase product;

- (b) **moving the solid particles** in a substantially horizontal solid transport direction from an upstream horizontal position to a downstream horizontal position;
- (c) **introducing the liquid feed material to the fluid bed at a feed zone located between the upstream horizontal position and the downstream horizontal position** in order to facilitate the conversion of the liquid feed material into the vapor phase product; and
- (d) collecting the vapor phase product.

Thus, a “**fluid bed**” is provided which is defined as comprising the solid particles and the fluidizing medium moving in a substantially vertical fluidizing direction. Further, the solid particles are moved in the fluid bed in the substantially horizontal solid transport direction from the upstream horizontal position to the downstream horizontal position. The liquid feed material is introduced to the fluid bed at the feed zone, wherein the feed zone is located between the upstream and downstream horizontal positions.

As described in further detail in the Application at Page 9, line 28 - Page 10, line 2:

“In a preferred process aspect of the invention, a fluidizing medium such as a gas is introduced into a reactor to fluidize a bed of solid particles such that the fluidizing medium is moving in a substantially vertical fluidizing direction. The solid particles are transported substantially horizontally in a solid transport direction from a solids inlet at an upstream horizontal position in the reactor to a solids outlet at a downstream horizontal position in the reactor, preferably but not necessarily by the force of gravity. As the solid particles move through the reactor they are contacted by a liquid feed material comprising a liquid hydrocarbon. The liquid hydrocarbon is introduced into the reactor at a feed zone which is located downstream of the solids inlet.”

Further, referring to Figures 1 and 2, Page 11, line 23 - Page 12, line 3 of the Application states:

“The fluidizing medium (22) fluidizes solid particles (28) to produce a fluid bed (30). The solid particles (28) in the fluid bed (30) move in a substantially horizontal solid transport direction (32) from a solids inlet (34) at an upstream horizontal position to a solids outlet (36) at a downstream horizontal position. The solid particles (28) are collected in a solid collection apparatus (38) which is associated with the solids outlet (36).”

“A liquid feed material (40) is introduced into the reactor (20) at a feed inlet (42) which is located downstream of the solids inlet (34) so that the feed inlet (42) is between the solids inlet (34) and the solids outlet (36).”

Thus, as shown in Figures 1 and 2 of the Application, the reactor (20) is divided into a number of zones, including a solid feed zone (60) and a liquid feed zone (62), each having a different function. (Page 13, lines 10 - 14 of the Application). The liquid feed zone (62) is located downstream of the solid feed zone (60). Further, the liquid feed material (40) is introduced in the liquid feed zone (62) to the fluid bed (30) comprising the solid particles (28) fluidized by the fluidizing medium (22).

Further, the step of “introducing the liquid feed material to the fluid bed at the feed zone” is further defined in dependent Claims 10 - 14. In particular, Claim 10 claims “wherein the step of introducing the liquid feed material to the fluid bed at the feed zone is comprised of spraying the liquid feed material so that the liquid feed material contacts the solid particles as droplets.” Further, Claim 11 claims “wherein the liquid feed material is sprayed within the fluid bed so that the droplets penetrate the fluid bed.”

Claim 12 claims “wherein the liquid feed material is sprayed so that the droplets contact the solid particles from a spraying direction which is substantially perpendicular to the solid transport direction.” Further, Claim 13 claims “wherein the spraying direction is a substantially vertical direction.” As well, Claim 14 claims “wherein the spraying direction is substantially opposite to the fluidizing direction.”

The liquid feed delivery is particularly described in the Application at Page 18, line 13 - Page 19, line 10. In addition, Page 19, lines 31 - 34 of the Application states that “adequate momentum is imparted to the feed droplets to allow some penetration of the liquid feed material (40) into the fluid bed (30).”

Finally, Claim 18 further defines the step of moving the solid particles. In particular, Claim 18 claims “wherein the solid particles are moved in the solid transport direction at **a rate which is significantly larger than a rate of mixing of the solid particles in the solid transport direction.**”

In other words, “the Peclet (Pe) number describing the movement of the solid particles is relatively large so that the movement of the solid particles in the solid transport direction approaches plug-flow” (Page 8, lines 7 - 11 of the Application). As particularly described in the Application at Page 21, lines 3 - 10:

“The assumption of plug-flow is an ideal case where every solid particle (28) has the same horizontal velocity. The solid particles (28) move along the length of the reactor (20) in uniform plugs that are well mixed in the radial direction. Since every solid particle (28) has the same horizontal velocity, there can be no mixing along the length of the reactor (20). In the process of the invention, the solids RTD [Residence Time Distribution] approaches the plug-flow ideal since the bulk rate of solids flow along the length of the fluid bed (30) is much larger than the rate of solids mixing in the same direction. In engineering terms, this is equivalent to stating that the Peclet (Pe) number is relatively large.”

Anticipation (Jewell et. al.)

As stated above, the Examiner has rejected Claims 1 - 15, 19 - 21 and 25 under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 2,717,867 issued September 13, 1955 to Jewell et. al.

Jewell et. al. is directed at an improved process for hydrocarbon conversion which involves a coking treatment performed in a drum (19), as shown in Figures 1 - 3, which maintains “a fluidized bed of coke.” Further, the coking treatment involves contacting a preheated oil with hot finely divided coke in a “coking zone.” (Column 2, lines 45 - 53 of Jewell et. al.). However, as discussed in detail below, **the contacting of the oil and the coke within the coking zone takes place prior to the introduction of the oil/coke mixture into the fluidized bed.**

Specifically, as stated at Column 3, lines 35 - 41 of Jewell et. al.:

“The hot finely divided coke **and** the preheated residual oil are discharged into the right hand end of the drum 19, preferably **at a point substantially above the upper surface of the fluid bed of coke**, under conditions such that the relatively vaporizable portion of the oil is rapidly vaporized and the unvaporizable portion is absorbed by the hot coke particles being introduced into drum 19.”

Thus, as clearly shown in Figures 1 - 3 of Jewell et. al., the coke particles and the oil are discharged into the drum together to permit their contact above the surface of the fluid bed in order to provide for an initial vaporization of a portion of the oil. Following the initial contact between the coke particles and the oil, the remaining unvaporized oil is absorbed by the coke particles and the **combination or mixture of the coke particles and absorbed oil** falls into the fluid bed.

As further stated at Column 3, lines 42 - 48 of Jewell et. al., “the relative proportions of oil and hot coke charged to drum 19 are controlled to provide sufficient absorbent surface in relation to the unvaporized portion of the oil, whereby the latter may be absorbed by the coke while the coke remains sufficiently dry that it can be fluidized by the aerating and stripping gas flowing upwardly through distribution plate 20.” In other words, the particles of coke are fluidized following the absorption of the oil thereby. The coke particles are not fluidized prior to contacting the oil.

This process is in clear contrast with the Applicant’s process as claimed in Claim 1 which comprises providing a fluid bed comprising solid particles and a fluidized medium, moving the solid particles in a substantially horizontal solid transport direction from an upstream horizontal position to a downstream horizontal position and **introducing the liquid feed material to the fluid bed** at a feed zone located between the upstream and downstream horizontal positions.

In the Applicant’s process, as claimed in Claim 1, the solid particles comprise the fluid bed and move in the fluid bed from the upstream to the downstream horizontal positions. The liquid feed material is introduced to the fluid bed at the feed zone between the upstream and downstream horizontal positions. Thus, the solid particles are fluidized by the fluidizing medium prior to or concurrently with the contact with the liquid feed material. In other words, **the liquid feed material is introduced to and contacted with fluidized solid particles in the fluid bed.**

In Jewell et. al. **the oil (“liquid feed material”) is introduced to and contacted with the coke particles (the “solid particles”) apart from the fluid bed**, particularly at a point substantially above the surface of the fluid bed. Thus, the coke particles are not fluidized at the point of contact with the oil, as required by the Applicant’s process. Rather, following the initial contact between the oil and non-fluidized coke particles, a portion of the oil is absorbed by the coke particles and the resulting oil/coke particle mixture or combination is subsequently permitted to fall into the fluid bed. Thus, only the resulting oil/coke particle mixture or combination is fluidized within the fluid bed.

These distinctions are particularly apparent in the preferred embodiment of Jewell et. al. as shown in Figures 1 - 3. Column 3, lines 58 - 74 of Jewell et. al. states:

“Preferably, the temperatures of the hot coke and oil charged into drum 19 and the relative proportions of each are controlled to effect rapid vaporization of the oil and absorption of unvaporized constituents, **whereby little or no liquid oil falls on the upper surface of the fluid bed of coke.** This may be effected by discharging hot finely divided coke in an aerated condition into the interior of drum 19 at a high point therein while simultaneously spraying the hot residual oil into the interior of drum 19 at a point nearby the point at which the aerated coke is being introduced. The spray of oil is directed into the aerated mass of coke being introduced, to effect intimate contact of the hot coke and oil. This produces rapid vaporization of a portion of the oil and the unvaporized portion is absorbed by the coke which is settled onto the upper surface of the fluid bed of coke distribution plate 20.”

Further, the intimate contact of the hot oil and coke, or mixing of the hot oil and coke, is preferably achieved in a separate confined zone, referred to as the “vaporizing section” of the coking zone, “whereby part of the oil is vaporized and the unvaporized remainder is substantially completely absorbed by the hot coke, prior to discharge of the resulting mixture into drum 19 at a point from which the coke particles may settle onto the fluidized bed of coke.” (Column 3, line 75 - Column 4, line 7 of Jewell et. al.)

The separate confined zone may be provided outside the drum (19). However, preferably, the separate confined zone is provided in the upper interior of the drum (19) by

partitioning off a space around the inlets for the oil and coke. Referring to Figures 1 and 2, a partition is provided in the form of a truncated cone (24). (Column 4, lines 7 - 14 of Jewell et. al.).

Column 4, lines 12 - 26 of Jewell et. al states:

“... a partition in the form of a truncated cone 24, open at the lower small end, is attached to the upper interior wall of drum 19. Line 17 connects with a spray head 25 mounted at the top of drum 19 and arranged to spray the hot residual oil downwardly within the vaporizing section, of the coking zone, defined by partition 24. The finely divided hot coke for the coking treatment is supplied from standpipe 26 as an aerated mass. ... The hot finely divided coke from standpipe 26 is discharged into the mixing section of the coking zone provided by partition 24 and into intimate contact with the oil being sprayed therein.”

In order to assist in the mixing of the hot coke and oil within the vaporizing section of the coking zone, an extraneous gas may be directly introduced into the mixing section, such as through line (29). The tangential introduction of the extraneous gas from line (29) through inlets (30) produces a swirling movement of the coke particles and oil droplets whereby there is intimate contact of the oil and hot coke within the vaporizing section and prior to discharge of the resulting mixture of oil vapors and hot coke, through the exit (31) of the partition (24). (Column 4, lines 34 - 46 of Jewell, et. al.).

As indicated above, the contact between the oil and coke particles is performed in a manner such that “little or no liquid oil falls on the upper surface of the fluid bed.” This express feature of the process of Jewell et. al. is further confirmed at Column 4, lines 53 - 58 as follows:

“It is preferred that vaporization of oil and absorption of the residue shall be accomplished solely by the coke with which the oil is first contacted in the mixing zone and that substantially no unabsorbed liquid oil be precipitated onto the surface 21 of the coke bed.”

In order to anticipate a claim, the reference must teach each and every element of the claim (U.S. Manual of Patent Examining Procedure “MPEP” §2131). It is respectfully submitted that Jewell et. al. does not teach each and every element of at least independent Claim 1 and dependent Claims 10 - 14, and therefore, at least Claims 1 and 10 - 14 are not anticipated by Jewell et. al.

Specifically, Jewell et. al. does not teach, describe or suggest in any manner a process comprising providing a fluid bed comprising solid particles and a fluidized medium, wherein the fluidized medium is moving in a substantially vertical fluidizing direction, moving the solid particles in a substantially horizontal solid transport direction from an upstream horizontal position to a downstream horizontal position and introducing the liquid feed material to the fluid bed at a feed zone located between the upstream and downstream horizontal positions, as claimed in independent Claim 1.

As described in detail above, in the Applicant's process, the solid particles are fluidized by the fluidizing medium prior to or concurrent with the contact with the liquid feed material. Thus, the liquid feed material is introduced to and contacted with fluidized solid particles in the fluid bed. In clear contrast, in Jewell et. al. the liquid feed material is introduced to and contacted with the solid particles apart from the fluid bed, particularly at a point substantially above the surface of the fluid bed. Thus, the coke particles are not fluidized at the point of contact with the oil.

Further, Jewell et. al. does not teach, describe or suggest in any manner the step of introducing the liquid feed material to the fluid bed at the feed zone being “comprised of spraying the liquid feed material so that the liquid feed material contacts the solid particles as droplets” as claimed in Claim 10.

As indicated above, the liquid feed material is introduced to the fluid bed at the feed zone. Thus, pursuant to Claim 10, the liquid feed material is sprayed into the fluid bed at the feed zone. In contrast, Jewell et. al. does not spray the liquid feed material (oil) into the fluid bed, but rather, sprays the liquid feed material onto the solid particles (coke particles) above the fluid bed, prior to introduction to the fluid bed.

Similarly, Jewell et. al. does not teach, describe or suggest in any manner the spraying of the liquid feed material “within the fluid bed so that the droplets penetrate the fluid bed”, as claimed in Claim 11. Clearly Jewell et. al. specifically teaches away from the spraying of droplets of the liquid feed material within the fluid bed to penetrate the fluid bed. As discussed

above, the intent of Jewell et. al. is to vaporize or absorb all of the oil upon contact with the coke particles “whereby little or no liquid oil falls on the upper surface of the fluid bed of coke.”

Finally, Jewell et. al. does not teach, describe or suggest in any manner the “spraying direction” into the fluid bed, as claimed by the Applicant in Claims 12 - 14.

For instance, Claim 12 claims “wherein the liquid feed material is sprayed so that the droplets contact the solid particles from a spraying direction which is substantially perpendicular to the solid transport direction.” The “solid transport direction” is defined by the Applicant in Claim 1 as the direction of movement of the solid particles in the fluid bed. Jewell et. al. does not spray the liquid feed material into the fluid bed, but rather into a vaporizing section above the fluid bed.

Obviousness (Jewell et. al.)

In addition, as indicated above, the Examiner has rejected dependent Claim 18 under 35 U.S.C. 103(a) as being unpatentable over Jewell et. al.

Claim 18 depends from Claim 1. Therefore, the Examiner’s rejection is based, at least in part, upon the view that all of the features of Claim 1 are anticipated by Jewell et. al. However, as indicated above, it is respectfully submitted that each and every feature of Claim 1 is not shown by Jewell et. al. As all of the features of Claim 1, and therefore Claim 18, are not shown by the prior art, it is respectfully submitted that Claim 18 is not obvious.

In addition, the Examiner expressly confirms that “Jewell does not disclose wherein the solid particles are moved in the solid transport direction at a rate which is significantly larger than a rate of mixing of the solid particles in the solid transport direction”, as claimed in Claim 18.

However, the Examiner states that Claim 18 is obvious in view of the description in Jewell et. al. that the residence time of the solid particles in the drum (19) can be varied by varying the rate of discharge of the solid particles into the drum and the quantity of solid particles in the drum.

As described above, preferably the Applicant's process provides for "the solid particles (28) to move along the length of the reactor (20) in uniform plugs that are well mixed in the radial direction. Since every solid particle (28) has the same horizontal velocity, there can be no mixing along the length of the reactor (20)." Thus, the solids residence time distribution "approaches the plug-flow ideal since the bulk rate of solids flow along the length of the fluid bed (30) is much larger than the rate of solids mixing in the same direction."

It is respectfully submitted that although Jewell et. al. may discuss varying the solids residence time in the drum, Jewell et. al. provides limited guidance or direction regarding the desired residence time to be achieved. Specifically, Jewell et. al. simply states that the "time of residence of the coke particles in the fluid bed in drum 19 is sufficient to provide the soaking time required to complete the coking of the residual hydrocarbons deposited on the coke particles and the evolution of hydrocarbons released by the coking reaction" (Column 5, lines 35 - 39 of Jewell et. al.).

There is no discussion or guidance provided by Jewell et. al. regarding the importance or desirability of achieving "plug flow", as claimed by the Applicant. Therefore, it is respectfully submitted that varying of the solids residence time to achieve this feature would not be obvious to a person having ordinary skill in the art.

Anticipation (Harper)

The Examiner has also rejected Claims 1, 16, 17 and 22 - 24 under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 2,895,906 issued July 21, 1959 to Harper.

Harper relates to "the contacting of a mass of fluidized solids with fluid streams" (Column 1, lines 15 - 16 of Harper). However, the specific manner of contacting the solids with the fluids differs from that claimed by the Applicant.

Specifically, Harper provides fluidized solids in a single chamber, wherein the "fluidized solids flow in a cyclic manner through separate contact zones arranged in sequence within the single chamber." The zones are formed by vertically partitioned baffles within the chamber and comprise, "in sequence, an energizing zone, a reaction zone, a stripping zone, a

regeneration zone, and a second stripping zone.” (Column 2, lines 23 - 34 of Harper). A single fluid is injected into each of the zones of Harper.

More particularly, referring to Figures 1 and 2, Harper provides a chamber having a circular wall (10), a closed bottom floor (12) and a closed top ceiling (13). The interior of the chamber is divided into five zones. In sequence, the chamber provides the energizing zone (19), the reaction zone (20), the first stripping zone (21), the regeneration zone (22) and the second stripping zone (22). Separate or distinct fluids are introduced into each of the zones. (Column 3, line 62 - Column 4, line 11 of Harper).

As shown in Figure 1, the liquid feed stock (i.e. the “liquid feed material”) is introduced by line (25) into a single zone only, being reaction zone (20). No other or further fluids are introduced into the reaction zone (20). Specifically, Harper indicates that a distributing header (24) is provided adjacent floor (12) in order to provide uniform distribution of the hydrocarbon feed stock into the reaction zone (20) through line (25). (Column 4, lines 10 - 16 of Harper). The distribution of the hydrocarbon feed stock into the reaction zone (20) is not discussed by Harper in any further detail.

Similarly, a separate fluid distributor is provided in each of the remaining zones for distributing a single fluid therein, as described at Column 4, lines 17 - 30 of Harper:

- (a) “Fluid distributor 26 adjacent floor 12 provides uniform distribution of steam entering through line 27 throughout ... **first stripping zone 21**”;
- (b) “Distributor header 28 in **regeneration zone 22** provides for uniform distribution of air entering through line 29 adjacent floor 12...;
- (c) “Distributor header 30 adjacent floor 12 in **second stripping zone 23** provides for the uniform distribution of steam entering through line 31 ...; and
- (d) “Steam is introduced into **energizing zone 19** through line 32 by means of distributor 33 located in the bottom section of energizing zone 19 adjacent floor 12.”

Steam is injected into the energizing zone (19) in order to develop a pressure differential between the zones resulting in the cyclic flow of the finely divided solid particles through the zones. The injection of steam into the energizing zone (19) also lifts the solids entering the energizing zone (19) from the second stripping zone (23) over the baffle into the reaction zone (20). Finally, the steam injected into the energizing zone (19) serves to develop the fluidized condition of the solid particles. The steam or air injected into each of the other zones also aids in maintaining the fluidized condition through the chamber. (Column 2, line 72 - Column 3, lines 13; Column 5, lines 37 - 54 of Harper).

Thus, with respect to the fluidization of the fluid bed of Harper, each of the energizing zone (19), first stripping zone (21), regeneration zone (22) and second stripping zone (23) introduces one of either steam or air therein in order to fluidize the catalytic particles (i.e., the “solid particles”) contained in the fluid bed. Thus, the “fluidizing medium” of Harper is comprised of either air or steam which is introduced by the various lines into the respective zones (19, 21, 22, 23). **The liquid feed stock is not introduced to the fluid bed in any of these further zones (19, 21, 22, 23).**

Accordingly, in summary, Harper provides for 5 zones, wherein **a single fluid is introduced to the fluid bed in each of the zones in sequence**. The hydrocarbon feed stock (i.e. the “liquid feed material”) is introduced into reaction zone (20) only. The reaction zone (20) does not introduce any further fluids therein, including either air or steam (i.e. a “fluidizing medium”). Conversely, each of the remaining zones (19, 21, 22, 23) introduces one of either steam or air (the “fluidizing medium”) therein. However, none of these zones (19, 21, 22, 23) introduce any further fluids therein, including the feed stock (i.e. a “liquid feed material”).

As set out above, in order to anticipate a claim, the reference must teach each and every element of the claim (U.S. Manual of Patent Examining Procedure “MPEP” §2131). It is respectfully submitted that Harper does not teach each and every element of at least independent Claim 1, and therefore Claim 1 is not anticipated by Harper.

Specifically, Harper does not teach, describe or suggest in any manner a process comprising providing a fluid bed comprising solid particles and a fluidized medium, wherein the

fluidized medium is moving in a substantially vertical fluidizing direction, moving the solid particles in a substantially horizontal solid transport direction from an upstream horizontal position to a downstream horizontal position and introducing the liquid feed material to the fluid bed at a feed zone located between the upstream and downstream horizontal positions, as claimed in independent Claim 1.

As described in detail above, in the Applicant's process, a **fluid bed** is provided **comprised of the solid particles and the fluidizing medium**. Further, **the liquid feed material is introduced to the fluid bed at a feed zone in the fluid bed**. Accordingly, the liquid feed material is introduced into a fluid bed comprising the solid particles and the fluidizing medium. In other words, **at the feed zone of the fluid bed**, the solid particles are fluidized by the fluidizing medium moving in a substantially vertical fluidizing direction **AND** the liquid feed material is introduced.

In contrast, Harper introduces the liquid feed material (i.e. the liquid feed stock) to a reaction zone (20) of the fluid bed that does not include a fluidizing medium moving in a substantially vertical fluidizing direction. The solid particles flow through the reaction zone (20) as a result of the introduction of air or steam to the other zones (19, 21, 22, 23) of the apparatus and the pressure differential between the zones (Column 2, line 61 - Column 3, line 21; Column 5, lines 37 - 54 of Harper). The liquid feed stock is not introduced to the fluid bed in any of the other zones (19, 21, 22, 23).

Summary -

Thus, in summary, it is respectfully submitted that neither Jewell et. al. nor Harper, alone or in combination, teaches, discloses or suggests the Applicant's process, as claimed in independent Claim 1. It is therefore respectfully submitted that independent Claim 1 is allowable and allowance of Claim 1 is respectfully requested.

Further, dependent Claims 2 - 25 depend directly or indirectly from independent Claim 1. Thus, it is respectfully submitted that these dependent Claims are allowable for the distinctions defined therein as well as for the reasons supporting the allowability of Claim 1. Accordingly, allowance of all of the above noted dependent Claims is also respectfully requested.

In view of the foregoing amendments and remarks, it is submitted that this Application is in condition for allowance and allowance of all of Claims 1 - 25 is respectfully requested.

Respectfully submitted,

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